

PROTECTING NEURAL STRUCTURES AND COGNITIVE FUNCTION DURING PROLONGED SPACE FLIGHT BY TARGETING THE BRAIN DERIVED NEUROTROPHIC FACTOR MOLECULAR NETWORK

M. A. Schmidt¹ and T. J. Goodwin²

¹Advanced Pattern Analysis & Countermeasures Group, MetaboLogics, Research Innovation Center, Infectious Disease Research Complex, Colorado State University, Fort Collins, CO; ²Biomedical Research and Environmental Sciences Division, Disease Modeling and Tissue Analogues Laboratory, NASA Johnson Space Center, Houston, TX

Brain derived neurotrophic factor (BDNF) is the main *activity-dependent* neurotrophin in the human nervous system. BDNF is implicated in production of new neurons from dentate gyrus stem cells (hippocampal neurogenesis), synapse formation, sprouting of new axons, growth of new axons, sprouting of new dendrites, and neuron survival. Alterations in the amount or activity of BDNF can produce significant detrimental changes to cortical function and synaptic transmission in the human brain. This can result in glial and neuronal dysfunction, which may contribute to a range of clinical conditions, spanning a number of learning, behavioral, and neurological disorders.

There is an extensive body of work surrounding the BDNF molecular network, including BDNF gene polymorphisms, methylated BDNF gene promoters, multiple gene transcripts, varied BDNF functional proteins, and different BDNF receptors (whose activation differentially drive the neuron to neurogenesis or apoptosis). BDNF is also closely linked to mitochondrial biogenesis through PGC-1 α , which can influence brain and muscle metabolic efficiency.

BDNF AS A HUMAN SPACE FLIGHT COUNTERMEASURE TARGET

Earth-based studies reveal that BDNF is negatively impacted by many of the conditions encountered in the space environment, including oxidative stress, radiation, psychological stressors, sleep deprivation, and many others. A growing body of work suggests that the BDNF network is responsive to a range of diet, nutrition, exercise, drug, and other types of influences. This section explores the BDNF network in the context of 1) protecting the brain and nervous system in the space environment, 2) optimizing neurobehavioral performance in space, and 3) reducing the residual effects of space flight on the nervous system on return to Earth.